Application No. 09/719,907
Amendment dated April 17, 2003
Reply to Office Action of December 18, 2002

Remarks begin on page 8 of this paper.

Amendments to the Specification:

Please replace the title "**CROSS MEASUREMENT OF ACOUSTIC FLOWMETER SIGNALS"** with the following --**A METHOD FOR MEASURING DISPLACEMENT OF A FLUID IN A CONDUIT**--.

Please replace the paragraph at page 1, line 33, with the following rewritten paragraph:

C1

--In the general field of flow measurement and fluid flow measurement in particular, numerous techniques employing ultrasound devices have been proposed. The majority of these systems employ the so-called transit time method. FIG. 1 shows a diagram of a prior art flowmeter, of the single-chord type. First and second ultrasound transducers 1 and 2 are provided at the side of the conduit 3 through which the fluid is flowing in a direction shown by arrow 4. In the example of FIG. 1, the conduit is cylindrical with a circular cross-section and the two transducers are arranged on diametrically opposed generating lines. Additionally, the two transducers are offset along conduit [2]3. A chord here is the line joining the centers of the transducers 1 and 2. It makes an angle θ with the main axis of flow, which is the axis of revolution of the conduit in the example of FIG. 1. L indicates the length of the chord and D the inside diameter of the conduit. If the first transducer 1 sends an ultrasound wave, it is detected, after propagation, by the second transducer 2 after a certain time shift T_{12} known as the transit time. If c is the speed of sound in the fluid and V the mean velocity of the fluid along the chord, T_{12} is given by the relation:--

Please replace the paragraph at page 3, line 2, with the following rewritten paragraph:

C2

--In this formula, T_1 and T_2 are respectively the propagation time of the ultrasound wave in the non-flow part of the stream, outside diameter D, for paths from the first transducer to the second, and from the second transducer to the first. T_1 and T_2 are equal except in the particular case where movement exists in these non-flow regions. These times correspond in particular to the time taken for the ultrasound wave to pass through the various layers of the materials constituting the transducer and the region of coupling between the transducer and the [fluid vein]flowing fluid. K_h is the hydraulic coefficient of the ultrasound flowmeter. Its purpose is to correct sampling at the time of measurement. In effect, the principle of transit time difference gives a

C2 cont

measurement of mean velocity of flow along the measurement chord linking the transducers. This chord is not necessarily representative of the total flow surface area. This leads to an error in the calculated flow rate which depends on the actual velocity profile inside the cross-section of flow. The purpose of K_h is to correct this error. This coefficient is generally set after laboratory measurements for a certain range of flow rate values.—

Please replace the paragraph at page 5, line 9, with the following rewritten paragraph:

C3

--A calibration step by measuring ultrasound propagation time outside the [fluid vein] flowing fluid can be provided.--

Please replace the paragraph at page 5, line 14, with the following rewritten paragraph:

C4

--In one embodiment, the method comprises a step of correcting values of ultrasound propagation time outside the [fluid vein] flowing fluid, as a function of temperature.—

Please replace the paragraph at page 12, line 26, with the following rewritten paragraph:

C5

--Thus, the invention applies to any ultrasound flowmeter device having a plurality of transducers fixed at selected positions on the wall of a conduit through which the fluid the flow of which it is desired to measure is flowing. The conduit can be a conduit of any type, size and material employed in practice. The transducers can be fixed to the wall by conventional means, known per se. The invention further proposes calibrating the propagation times of the ultrasound outside the[fluid vein] flowing fluid, as indicated below. In the framework of conventional setups for flow measurement using transit times, the times T1 and T2 are identical since the two waves follow the same paths in opposite directions. Measurement of (T1 + T2)/2 can be done by successively filling the measurement sleeve fitted with the transducers with two pure liquids at a controlled temperature, of different velocities that are known very accurately; one can for example use water and ethyl alcohol. Transit time is measured for each pair of transducers in each medium. This leads to the obtaining of a linear system of two equations with the two unknowns, T1 + T2 and L; resolution of the system makes it possible to store accurate values of T1 and L in memory for use of formula (4) in an operational situation.--